PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER

ELGAR CORPORATION

PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER

INSTRUCTION MANUAL

PRECISION POWER
PRECISION POWER

SERIES 200
POWER SOURCE

PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER

SERIES 200
POWER SOURCE

TABLE OF CONTENTS

SECTION I — INTRODUCTION AND GENERAL DESCRIPTION

SCOPE OF MANUAL 1-1
INTRODUCTION 1-1
GENERAL DESCRIPTION 1-1

SECTION II — SPECIFICATIONS

SPECIFICATIONS 2-1

SECTION III — INSPECTION AND OPERATION

INSPECTION UPON RECEIPT 3-1
SINGLE-PHASE OPERATION 3-1
TWO-PHASE AND THREE-PHASE OPERATION 3-3

SECTION IV — THEORY OF OPERATION

GENERAL 4-1
CIRCUIT DESCRIPTION 4-1
OUTPUT TRANSFORMER 4-2
INPUT POWER 4-2
TWO-PHASE AND THREE-PHASE POWER SOURCES 4-2

SECTION V — MAINTENANCE

SERVICE INFORMATION 5-1
FACTORY REPAIR 5-1
ADJUSTMENTS 5-1
TROUBLESHOOTING 5-3

SECTION VI — PARTS LIST

CAPACITORS 6-2
RESISTORS 6-2
SEMICONDUCTORS 6-3
TRANSFORMERS 6-3
MISCELLANEOUS 6-3

LIST OF ILLUSTRATIONS

FIGURE

	FRONTISPIECE	
1-1	POWER OUTPUT DERATING vs OUTPUT VOLTAGE	1-2
1-2	TYPICAL HARMONIC DISTORTION	1-2
3-1	FRONT PANEL	3-2
3-2	REAR PANEL	3-2
3-3	REAR PANEL CONNECTIONS FOR TWO-PHASE AND THREE-PHASE OPERATION	3-4
5-1	TEST POINT AND ADJUSTMENT LOCATIONS	5-2
5-2	SCHEMATIC DIAGRAM OF ELGAR SERIES 200 POWER SOURCE	5-5

SECTION I

INTRODUCTION AND GENERAL DESCRIPTION

SCOPE OF MANUAL

This manual describes the Model 200 Power Source manufactured by Elgar Corporation. It provides operating, maintenance, and adjustment instructions; a circuit description; a schematic diagram; and a parts list.

INTRODUCTION

The Elgar Model 200 Power Source provides AC power at precise frequencies for testing, motor operation, and frequency conversion. The basic power amplifier consists of two DC supplies and a direct-coupled amplifier with a tapped power output transformer. The output transformer provides nominal output voltages of 28, 115, and 230 VAC that are adjustable between 0-30, 0-130, and 0-260 VAC. Total available power is 200 volt-amperes at full-rated outputs. Power at less than full-rated outputs is derated as illustrated in Figure 1-1. Shown in Figure 1-2 is a typical curve of harmonic distortion. Input power is single-phase 115 VAC at 60 Hz. Units operating with 230 VAC and/or 400 Hz input power are available on special order.

Output power frequency is established by a plug-in oscillator. Output frequency range is 45 to 10,000 Hz. The output is derated to half power, however, at frequencies between 5 KHz and 10 KHz. A variety of plug-in oscillators is available, with frequency accuracies up to 0.0001%.

The Elgar Power Source facilitates equipment tests to meet military-specification operating requirements over the frequency range of 47 to 63 Hz or 47 to 425 Hz. The basic power source output is single phase. Multi-phase power can be obtained, however, by stacking two or three power sources, all driven by the same multi-phase plug-in oscillator.

GENERAL DESCRIPTION

The Elgar Model 200 Power Source is contained in a rack-mount enclosure. A meter for output voltage monitoring, a POWER ON indicator lamp, a voltage AMPLITUDE control, and a POWER circuit-breaker that applies line power to the unit are located on the front panel. Cooling air is drawn through a front panel grill and exhausted at the rear of the enclosure.

The enclosure contains two heatsinks which comprise a two-section power amplifier. Control circuitry is mounted on a circuit board with test points and adjustment controls available at the top of the board. Output power is available at a rear panel terminal strip and at front panel connectors.

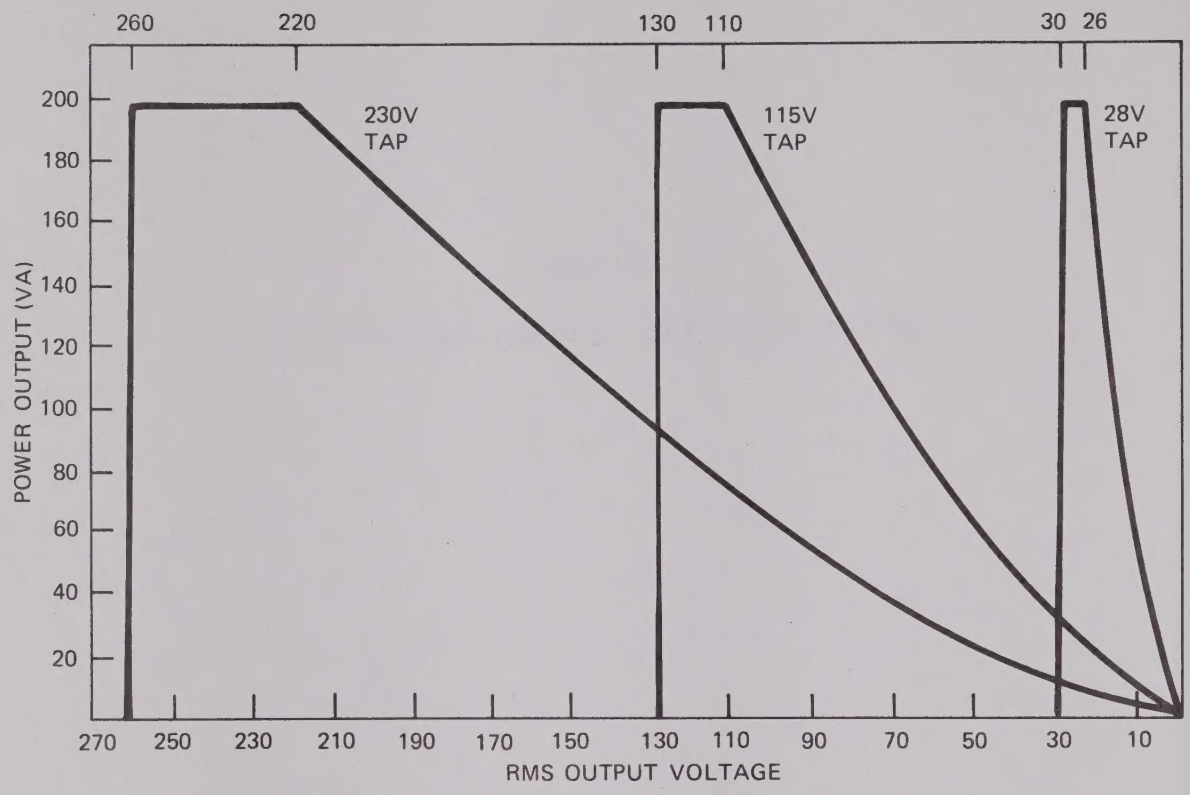

FIGURE 1-1. POWER OUTPUT DERATING vs OUTPUT VOLTAGE

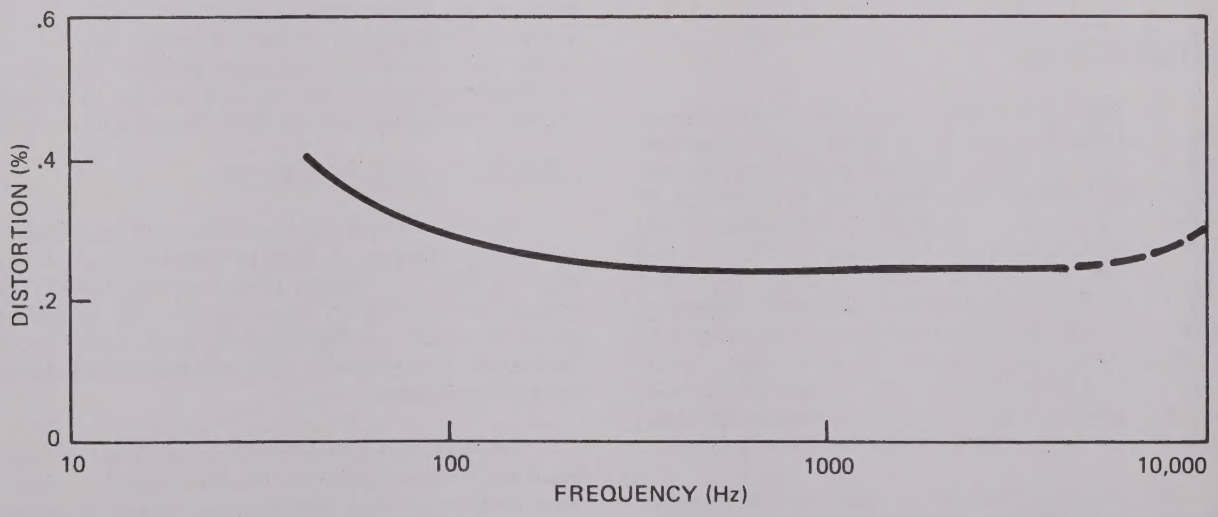

FIGURE 1-2. TYPICAL HARMONIC DISTORTION

SECTION II

SPECIFICATIONS

OUTPUT POWER	0 – 200 VA
POWER FACTOR	Unity to ±0.7
OUTPUT VOLTAGE	Adjustable 0 – 30 VAC, 0 – 130 VAC, or 0 – 260 VAC
OUTPUT FREQUENCY RANGE	45 Hz to 5000 Hz at full power output. 5000 Hz to 10,000 Hz at one-half power output
DISTORTION	Less than 1% – 45 Hz to 5000 Hz Less than 2% – 5000 Hz to 10,000 Hz Less than 1/2% Midband (400 – 1000 Hz)
LOAD REGULATION	±1% – 45 to 5000 Hz ±2% – 5000 Hz to 10,000 Hz Adjustable to zero for a specific load and frequency
LINE REGULATION	1/2% – 115 VAC ±10 VAC 1/2% – 230 VAC ±20 VAC
SHORT CIRCUIT PROTECTION	Output may be shorted indefinitely and recovers immediately when short is removed
INPUT POWER	115 VAC ±10 VAC, 45 Hz to 63 Hz 550 Watts Maximum 230 VAC ±20 VAC or 360 Hz to 440 Hz input power available on special order
TEMPERATURE RANGE	0 – 50°C
DIMENSIONS	5-1/4" x 19" relay rack panel by 14-1/2" deep overall
WEIGHT	Approximately 50 lbs.

SECTION III

INSPECTION AND OPERATION

INSPECTION UPON RECEIPT

The Elgar Power Source has been aligned, calibrated, and tested prior to shipment. The instrument is therefore ready for immediate use upon receipt. The following checks should be made, however, to assure that the instrument has suffered no damage during shipment.

1. Inspect the shipping container prior to acceptance from the carrier. If damage to the container is evident, remove the instrument from the container and visually inspect for damage to the instrument parts.

2. If any damage to the instrument or container is evident, a description of the damage should be noted on the carrier's receipt, and signed by the driver or carrier agent. Save all shipping containers and filler material for inspection.

3. Forward a report of any damage to the Elgar Service Department, which will provide instructions for repair or replacement of the instrument.

SINGLE-PHASE OPERATION

Single-phase operation of the power source requires the following steps:

1. Install the power source so that the flow of cooling air into the front grill and out the rear panel grill is unobstructed.

2. Insert the plug-in oscillator which provides the desired output frequency into the front panel opening (figure 3-1).

3. Connect jumpers between terminals of the rear panel terminal strip (figure 3-2) as shown on the rear panel.

   a. 115- and 28-volt operation – from left to right, jumper together the second and third terminals, jumper together the fourth and fifth terminals, and jumper together the sixth and seventh terminals. The 28-volt output is between the second and sixth terminals. The 115-volt output is between the second and fifth terminals or between the red and white posts on the front panel. The 28-volt output is not available on the front panel.

   b. 230-volt operation – jumper together the third and fourth terminals only. The 230-volt output is between the second and fifth terminals or between the red and white posts on the front panel.

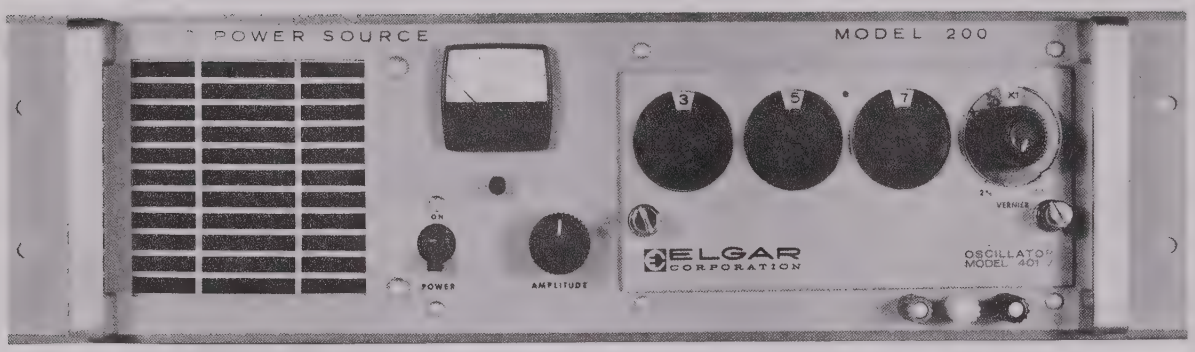

FIGURE 3-1. FRONT PANEL

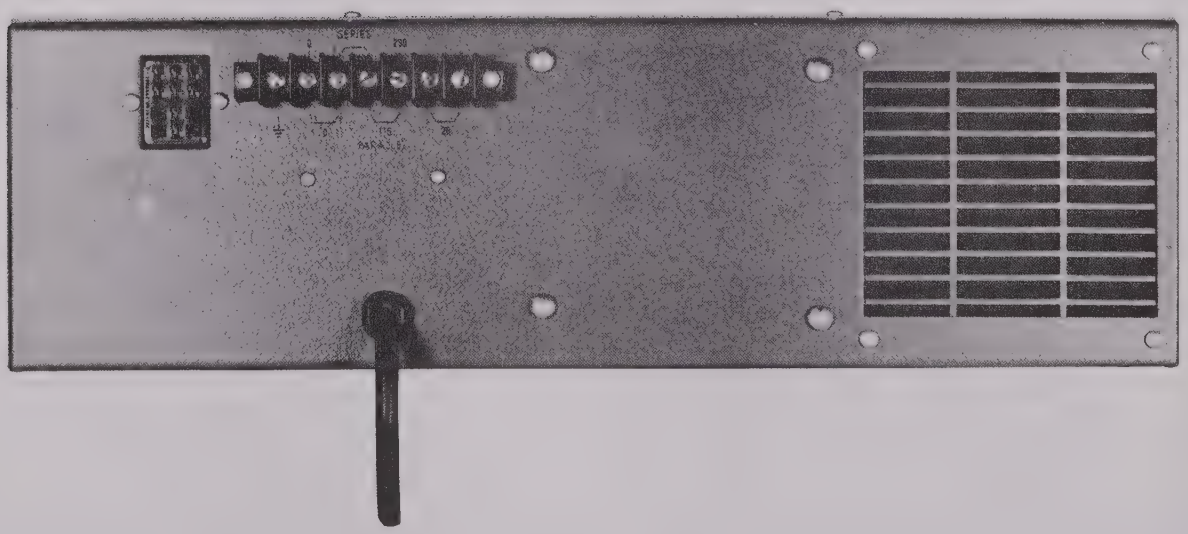

FIGURE 3-2. REAR PANEL

4. Connect the power output load to the rear panel terminal connectors or the front panel output posts.

5. Insert the power connector on the input power cord into the AC power outlet.

6. Set the front panel POWER circuit-breaker to ON. The indicator on the front panel is lighted when power is applied.

7. Adjust the front panel AMPLITUDE control for the desired output voltage. The front panel meter is wired to one of the 115-volt secondary windings of the output transformer. When operating at 28 or 230 volts, full scale output is indicated by a reading of 115 volts.

NOTE

Some Elgar plug-in oscillators do not require the use of the AMPLITUDE control. Consult the oscillator instruction manual.

TWO-PHASE AND THREE-PHASE OPERATION

Two-phase or three-phase operation of the power source requires the following steps:

1. Install each power source so that the flow of cooling air into the front panel grill and out the rear panel grill is unobstructed.

2. Insert the master oscillator in the master power source and the dummy oscillator(s) in the slave power source(s).

3. Insert the 12-pin plugs of the interconnecting cable into the 12-pin receptacles on the rear panels of the power source (figure 3-3).

4. Interconnect the terminal strips of the power sources in the desired configuration (figure 3-3).

5. Connect the power output load to the rear panel terminal connectors (figure 3-3).

6. Insert the power connectors on the input power cords into the AC power outlets.

7. Set the front panel POWER switches to ON. The indicators on the front panels are lighted when power is applied.

8. Adjust the master power source front panel AMPLITUDE control for the desired output voltage reading on the front panel meter. The front panel meter is wired to one of the 115-volt secondary windings of the output transformer. Full scale output is indicated by a reading of 115 volts on the front panel meter, regardless of how the output is connected. (Refer to note in SINGLE-PHASE OPERATION.)

9. Adjust the slave power source(s) front panel AMPLITUDE control(s) for the same reading on the master power source front panel meter. Any further adjustment of the output voltage is accomplished by adjusting the AMPLITUDE control of the master power source only. Do not disturb the AMPLITUDE control(s) of the slave power source(s) after the initial setting unless the character of the power output load (resistive, capacitive, or inductive) is changed or unless the rear panel interconnections are changed.

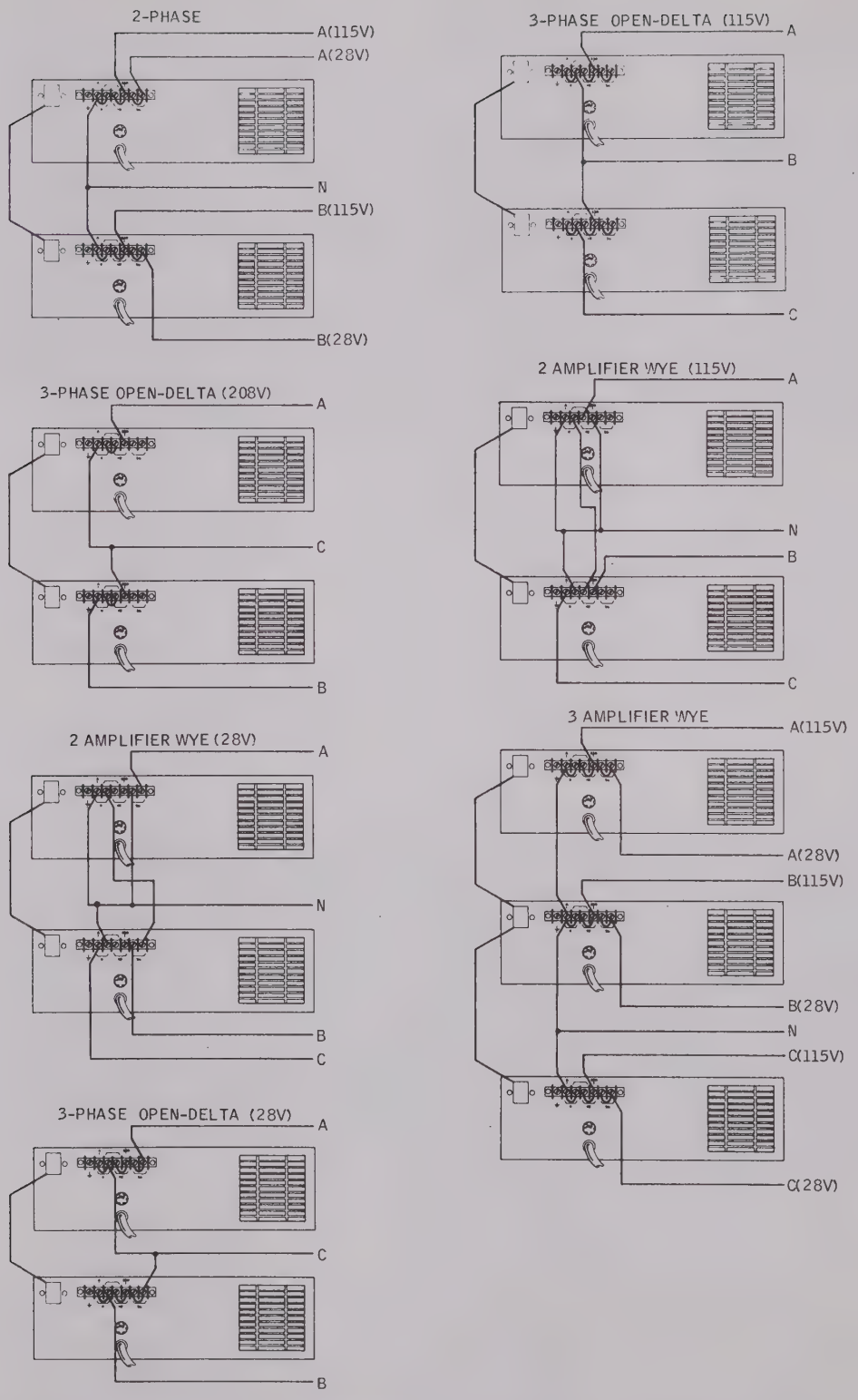

FIGURE 3-3. REAR PANEL CONNECTIONS FOR TWO-PHASE AND THREE-PHASE OPERATION

SECTION IV

THEORY OF OPERATION

GENERAL

This section discusses the principles of operation of the instrument. Figure 5-2 is a schematic diagram of the circuitry.

CIRCUIT DESCRIPTION

The input signal, at a nominal three volts AC full scale, is provided by the plug-in oscillator. The signal is applied to the first amplifier stage comprised of differential-pair transistor amplifiers Q1 and Q2. The differential pair provides high DC stability, inverts the signals and shifts the signal level to -40 volts. Potentiometer R7 provides DC balance adjustment for the differential pair. Diodes CR5 and CR10 are transistors used as Zener diodes to produce a regulated 12.4 volts at the junction of resistors R5 and R6. The collector-base junctions of CR5 and CR10 are forward-biased and the emitter-base junctions are operated at Zener breakdown. The 12.4 volts, in conjunction with R6 provides constant current to the emitters of Q1 and Q2.

The output of the differential amplifier stage is coupled to the base of transistor Q5 through emitter follower Q4. Transistor Q5 is a class A amplifier which provides the signal to the complementary driver stage, transistors Q7 and Q10.

The output section is a split circuit construction built on two heatsinks. Heatsink number one dissipates the heat for driver transistor Q7, parallel output transistors Q8, Q9, and Q14, and protective diode CR8. Heatsink number two dissipates the heat for corresponding transistors Q10 through Q13 and diode CR9.

Complementary driver transistors Q7 and Q10 are operated class AB. Driver transistor Q10 is used as a phase inverter, causing the output of heatsink number two to be inverted with respect to the output of heatsink number one. The output stage, consisting of transistors Q8, Q9, Q14, Q11, Q12, and Q13, is operated class B. The two sets of transistors are connected in series between the +40V and -40V power supplies.

To allow heatsink number one the same gain as heatsink number two, the junction of R14 and R15 is bootstrapped to the amplifier output through capacitor C10. Resistors R28, R29, and R37 are current splitters, connected in the emitter circuits of transistors Q8, Q9, and Q14, respectively. Resistors R31, R32, and R33 are current splitters connected in the emitter circuits of transistors Q11, Q12, and Q13, respectively. The total output current is summed at terminal 2 of output transformer T2 to drive the primary winding.

As the output voltage (a sine wave) approaches cross-over, the output transistors turn off (class B). To minimize cross-over distortion, the voltage drop across forward-biased diodes CR6 and CR7 overcomes the base-emitter threshold voltage of Q7 and Q10. The transistors permit a small current to flow in output transformer T2, so that while the output transistors are truly cutoff at cross-over, there is negligible threshold effect.

The amplifier has negative DC feedback through resistors R10 and R11 and decoupling capacitor C7. The negative feedback is applied to the base of Q1 to provide DC stabilization. Capacitor C6 provides high frequency stabilization.

AC feedback is provided by an additional winding of transformer T2, between terminals 3 and 4. The winding is wound bifilar with the primary for very close coupling. When a load is connected to the secondary windings of T2, a voltage difference between the primary winding and the bifilar winding is developed. The voltage difference is caused by the load current flowing in the primary winding. producing a voltage drop across the copper resistance of the winding. Sensing transformer T3 senses the voltage difference between the primary and bifilar windings. Positive current feedback is taken from the arm of potentiometer R23, through a frequency-compensating R-C network, and summed with inverse AC feedback from terminal 4 of T2 at the base of Q1. The feedback increases the input to the base of Q1, thereby compensating for the load current in the primary winding of T2. Potentiometer R23 is adjusted so that the no-load and full-load output voltages are the same within ±1%. Sensing the voltage drop across the copper resistance of the primary winding provides compensation which is independent of the temperature variation within the output transformer.

The output current limit, established by potentiometers R18 and R22, is normally set to occur at 1.75 to 2 amperes rms at 110 volts output. A portion of the voltage developed across R28 and R31 is picked off by R18 and R22 and applied to current-limiting transistors Q3 and Q6. As the current in the output transistors approaches the limit, the potentiometer outputs start driving the limiting transistors into conduction. The limiting transistors reduce the drive signal to the driver transistors (Q7 and Q10). Tunnel diodes CR13 and CR14 cause Q3 and Q6 to remain off until the limit threshold is reached and then turn on abruptly, thereby preventing distortion near the current limit threshold. To protect the output transistors during a short-circuited condition, additional drive to Q3 and Q6 is provided by resistors R39 and R40. As the output swing decreases, the voltage across R39 and R40 is increased, providing the additional drive for Q3 and Q6. No matter how heavily the amplifier is overloaded, transistor dissipation remains relatively constant. The output can be short-circuited indefinitely without damaging the amplifier, which recovers immediately when the short circuit is removed.

When the amplifier is overloaded, the current limiting causes the output current to become a square wave, the rms value of which is on the order of 2 amperes. Undistorted output current (maximum of approximately one ampere at short-circuit) can be delivered to low values of load impedance by reducing the input to the amplifier by means of the AMPLITUDE control.

OUTPUT TRANSFORMER

Output transformer T2 has split output windings. Normal output is 115 volts with the windings in parallel. Windings 5 through 10 are connected to a terminal strip on the outside of the rear panel. For 28-volt and 115-volt outputs, winding 5 is jumpered to winding 8, 6 to 9, and 7 to 10 on the terminal strip. Taken between windings 5 and 9, the output is 28 volts rms. Taken between windings 5 and 10, the output is 115 volts rms. Red and white terminals on the front panel are connected directly to windings 5 and 10 and the rear panel terminal strip, permitting 115 volts rms from the front panel. By removing jumpers between all terminals and installing a jumper between windings 7 and 8 only, the split windings of the output transformer are placed in series. The output is 230 volts rms between windings 5 and 10 and between the red and white binding posts on the front panel.

The front panel meter is wired to one of the 115-volt secondary windings of output transformer T2. When operating at 28 or 230 volts, full-scale output is indicated by a reading of 115 volts on the meter.

INPUT POWER

Input power is 115 volts at 45 to 63 Hz. Input power of 230 volts and/or 400 Hz is available on special order. A rectifier bridge assembly, denoted as diodes CR1 – CR4, provides full-wave rectification for the +40 and -40 VDC power supplies.

TWO-PHASE AND THREE-PHASE POWER SOURCES

Two or three power sources may be used to generate two-phase or three-phase AC power. Two-phase or three-phase signals are generated in a two-phase or three-phase plug-in oscillator installed in the master power amplifier. Signals from the oscillator are carried by interconnecting cables to one or two slave power amplifiers (see figure 3-3), each of which has a dummy oscillator plug-in which makes the required interconnections installed in it. The front panel AMPLITUDE control on the master amplifier controls the amplitude of all the amplifier outputs simultaneously. The front panel AMPLITUDE controls of the slave amplifier(s) however, must initially be set so that their output voltages equal the master amplifier output voltage.

Two-phase operation requires two power sources. Three-phase operation may be accomplished with three power sources in "Wye" connection, or with two power sources in either "Wye" or open-delta connection. The use of three power sources for three-phase operation provides 600 VA total power output while the use of two power sources provides 360 VA total power output. A more detailed circuit description of two-phase and three-phase power sources is provided in the Oscillator Instruction Manual.

SECTION V

MAINTENANCE

SERVICE INFORMATION

Questions concerning the operation, repair, or servicing of this instrument should be directed to the nearest Elgar representative or to the Service Department, Elgar Corporation, 8046 Engineer Road, San Diego, California. Include the model number and serial number in any correspondence concerning this instrument.

FACTORY REPAIR

Should it be necessary to return an instrument to the factory for repair, please contact the Elgar Corporation Service Department for authorization to make shipment. Do not return the unit for repair without authorization.

ADJUSTMENTS

The following adjustments should be checked at regular intervals and whenever the character of the load on the instrument (resistive, capacitive, or inductive) is changed. These adjustments can be performed with the aid of a Simpson 260A Multimeter and a Fluke Differential Voltmeter, or equivalent instruments, and an oscilloscope. Test points and adjustments are shown in figure 5-1.

DC BALANCE ADJUSTMENT

The DC balance adjustment prevents DC offset voltages which can cause large DC currents in the output transformer primary winding. Adjustment is accomplished with the front panel AMPLITUDE control set fully counterclockwise, or with the plug-in oscillator removed, to eliminate any signal input.

1. Measure the DC output voltage between TP2 (figure 5-1) and TP1 (common) using the 2.5-volt scale of the multimeter.
2. Adjust R7 to obtain a null (zero DC indication).
3. Set multimeter to the most sensitive current scale, such as the 1-milliampere or 50-microampere scale.
4. Adjust R7 to obtain a null (zero current indication).
5. Replace the plug-in oscillator (if it was removed).

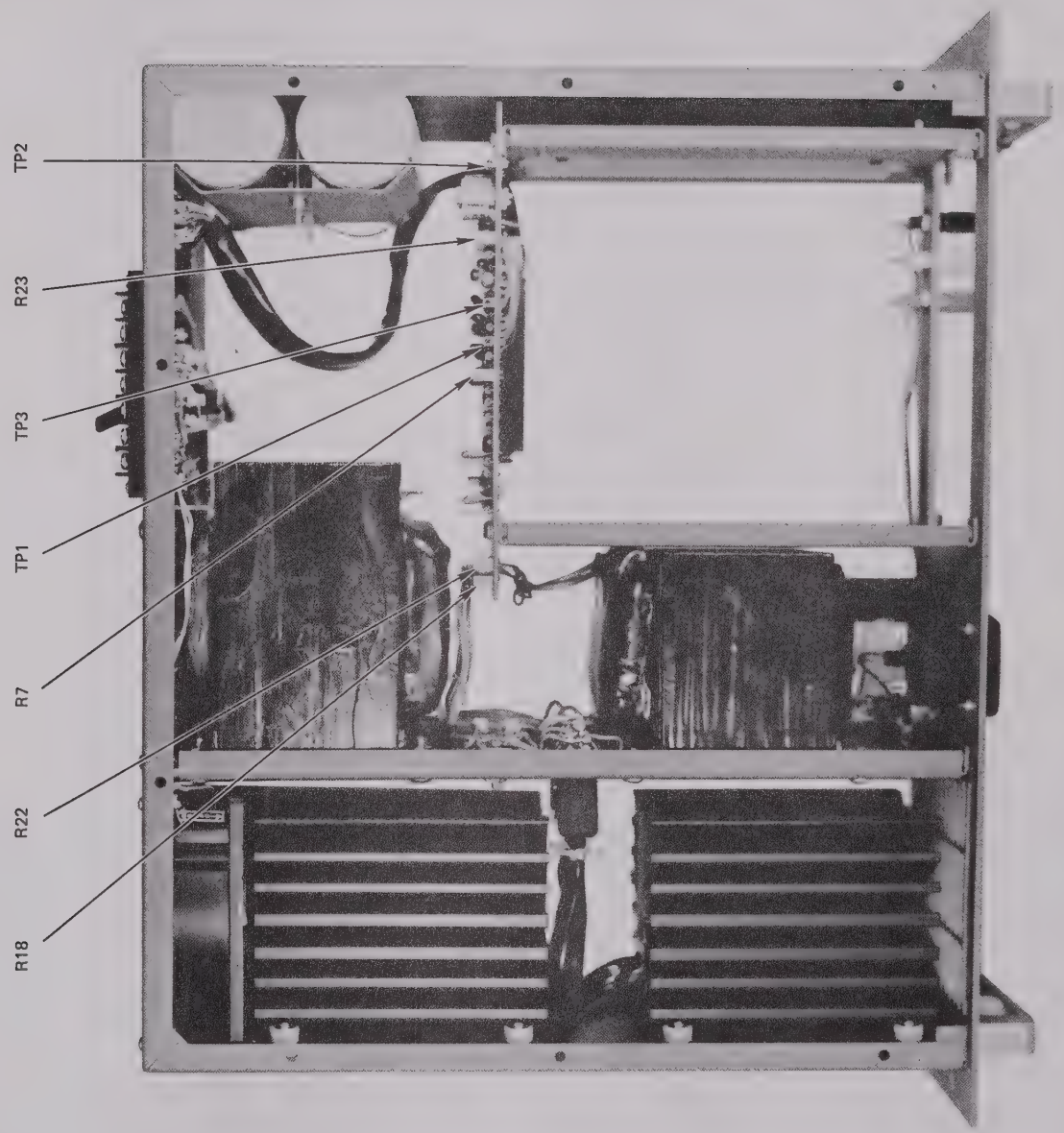

FIGURE 5-1. TEST POINT AND ADJUSTMENT LOCATIONS

CURRENT LIMITING ADJUSTMENT

Proper adjustment of the current limiting circuits prevents output distortion.

1. Connect an adjustable resistive load to the power source output. Adjust the load for 200-volt-ampere output at 110 volts (1.82 ampere).
2. Connect an oscilloscope to TP2 (figure 5-1).
3. Advance the positive current limiting control R18 in a clockwise direction until clipping of the positive peaks of the waveform is observed on the oscilloscope.
4. Turn R18 counterclockwise until clipping is no longer observed.
5. Advance the negative current limiting control R22 in a clockwise direction until clipping of the negative peaks of the waveform is observed on the oscilloscope.
6. Turn R22 counterclockwise until clipping is no longer observed.

REGULATED OUTPUT ADJUSTMENT

The output will remain within the specified ±1% after it has been adjusted for frequency and load conditions.

1. With the load disconnected from the power source, measure the output voltage with the differential voltmeter. The output voltage can be measured at the front panel output terminals.
2. Connect the power source to the normal operating load.
3. Measure the output voltage and adjust R23 (figure 5-1) until the output voltage is the same as that obtained under no-load conditions.

TROUBLESHOOTING

CIRCUIT-BREAKER

Continual tripping of the POWER circuit-breaker indicates failure of the rectifier bridge assembly (figure 5-2), a filter capacitor, or a power amplifier transistor. Pull out both heatsink connector plugs. Set the circuit breaker to ON. If it trips again, test the rectifier bridge assembly and filter capacitors. If it does not trip, check transistors Q7 through Q14 on the heatsinks.

OUTPUT DISTORTION

Output distortion is caused by improper setting of the current limiting adjustments or the DC balance adjustment. Consult the adjustment procedure given in this section of the manual.

ONE HEATSINK OVERHEATS

One heatsink overheating is caused by improper setting of the DC balance adjustment. Consult the adjustment procedure given in this section of the manual.

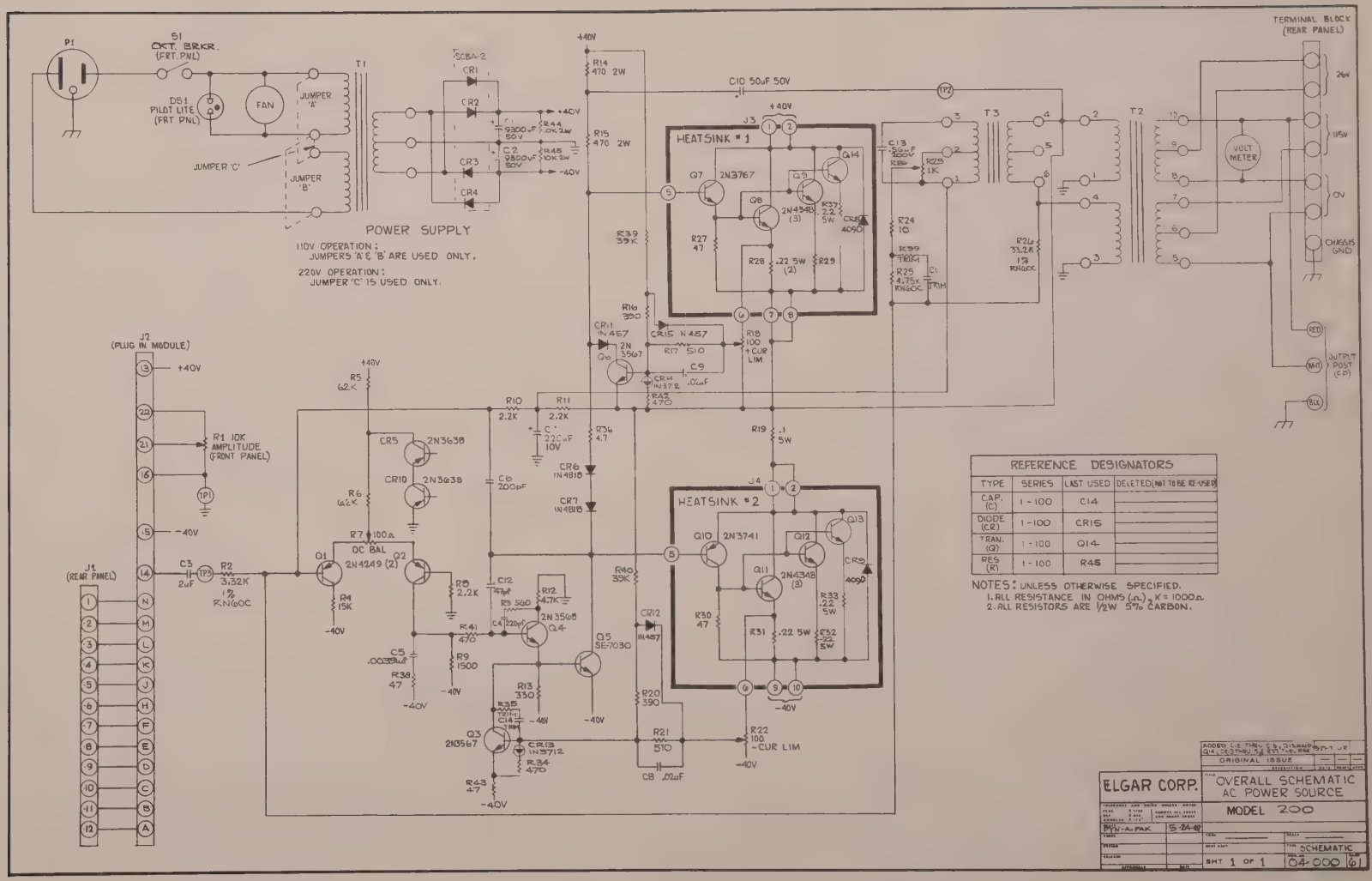

FIGURE 5-2. SCHEMATIC DIAGRAM OF ELGAR SERIES 200 POWER SOURCE

SECTION VI

PARTS LIST

SCHEMATIC DESIGNATION	VALUE	DESCRIPTION OR TYPE	RATING	MANUFACTURER	
				NAME	PART NO.
CAPACITORS					
C1, C2	9300 µf	ALUM ELECT	50V	GE	86F168M
C3	2 µf	MYLAR	200V 5%	ELPAC	ZD2A205J
C4	220 pf	DIP MICA	500V 5%	ARCO	DM15-221J
C5	.0039 µf	MYLAR		SPRAGUE	192P39292
C6	200 pf	DIP MICA	500V 5%	ARCO	DM15-201J
C7	220 µf	TANTALUM	10V	SPRAGUE	196D 227X0010GB
C8, C9	.02 µf	CER DISC	150V	CENTRALAB	DD203
C10	50 µf	ALUM ELECT	50V	SPRAGUE	TE1307
C11	FSV	MYLAR			
C12	47 pf	DIP MICA	500V 5%	ARCO	DM15-470J
C13	.56 µf	MYLAR	200V 5%	ELPAC	ZD2A564J
C14	FSV	CER DISC			
RESISTORS					
R1	10K	POTENTIOMETER		HELIPOT	7246R10K
R2	3.32K	METAL FILM	1/8W 1%	TEXAS INST	RN60C3321F
R3	560	CARB COMP	1/2W 5%	OHMITE	
R4	15K	CARB COMP	1/2W 5%	OHMITE	
R5, R6	6.2K	CARB COMP	1/2W 5%	OHMITE	
R7, R18, R22,	100	TRIMPOT		HELIPOT	78PR100
R8, R10, R11	2.2K	CARB COMP	1/2W 5%	OHMITE	
R9	1.5K	CARB COMP	1/2W 5%	OHMITE	
R12	4.7K	CARB COMP	1/2W 5%	OHMITE	
R13	330	CARB COMP	1/2W 5%	OHMITE	
R14, R15	470	CARB COMP	2W 5%	OHMITE	
R16, R20	390	CARB COMP	1/2W 5%	OHMITE	
R17, R21	510	CARB COMP	1/2W 5%	OHMITE	
R19	.1	W W	10W 5%	DALE	CW10
R23	1K	TRIMPOT		HELIPOT	78PR1K
R24	10	CARB COMP	1/2W 5%	OHMITE	
R25	4.75K	METAL FILM	1/8W 1%	TEXAS INST	RN60C4751F
R26	33.2K	METAL FILM	1/8W 1%	TEXAS INST	RN60C3322F
R27, R30, R38, R43	47	CARB COMP CARB COMP	1/2W 5%	OHMITE	
R28, R29, R31, R32, R33, R37	.22	W W	5W 5%	DALE	CW5
R34, R42	470	CARB COMP	1/2W 5%	OHMITE	
R36	4.7	CARB COMP	1/2W 5%	OHMITE	
R39, R40	39K	CARB COMP	1/2W 5%	OHMITE	
R44, R45	10K	CARB COMP	2W 5%	OHMITE	

SCHEMATIC DESIGNATION	VALUE	DESCRIPTION OR TYPE	RATING	MANUFACTURER	
				NAME	PART NO.
SEMICONDUCTORS					
CR1 – CR4		BRIDGE RECTIFIER ASSY	200V 25a	SEMTECH	SCBA-2
CR5, CR10		TRANSISTOR		FAIRCHILD	2N3638
CR6, CR7		RECTIFIER	200V 15a	WESTINGHOUSE	IN4818
CR8, CR9		RECTIFIER	200V 15a	WESTINGHOUSE	409D
CR11, CR12, CR15		DIODE	70V 50 ma	SYLVANIA	IN457
CR13, CR14		TUNNEL DIODE	1 ma	GE	TD712
TRANSISTORS					
Q1, Q2				FAIRCHILD	2N4249
Q3, Q6				FAIRCHILD	2N3567
Q4				FAIRCHILD	2N3568
Q5				FAIRCHILD	SE7030
Q7				MOTOROLA	2N3767
Q10				MOTOROLA	2N3741
Q8, Q9, Q11, Q12, Q13, Q14				RCA	2N4348
TRANSFORMERS					
T1		POWER TRANSFORMER		ELGAR	90-016-90
T2		OUTPUT TRANSFORMER		ELGAR	90-035-90
T3		SENSE TRANSFORMER		TRIAD	T31X
MISCELLANEOUS					
B1		FAN		PAMOTOR	4500
S1		CIRCUIT BREAKER	6.5a	HEINEMAN	JA1A3B

WARRANTY

Elgar Corporation warrants each instrument it manufactures to be free from defects in material and workmanship. The corporation's obligation under this warranty is limited to servicing the instrument and replacing defective parts, when the instrument is returned to the factory and transportation charges pre-paid. This warranty is effective for one year after delivery of the instrument to the original purchaser. Defects caused by improper operating conditions, misuse, negligence, or the alteration or removal of the nameplate, will void the warranty. Elgar Corporation shall in no circumstance be liable for any direct or consequential loss or damage of any nature resulting from the malfunction of the instrument. This warranty is effective in lieu of any or all other obligations or liabilities on the part of Elgar Corporation, its agents, or representatives.

ELGAR CORPORATION

FOR SALES AND SERVICE INFORMATION

contact our representative nearest your location

ARNOLD BARNES COMPANY
740 South Sherman St.
Richardson, Texas 75080
Phone: (214) 235-4541

3230 Mercer St.
Houston, Texas 77027
Phone: (713) 622-3620

E106 Petroleum Center
San Antonio, Texas 78209
Phone: (512) 828-1323

D. E. BOND ASSOCIATES
2149 S. Clermont St.
Denver, Colorado 80222
Phone: (303) 756-1234

P.O. Box 11331
Albuquerque, New Mexico 87112
Phone: (505) 247-3442

DEWAR & ASSOCIATES
6361 First Ave. South
Suite 12
Seattle, Washington 98108
Phone: (206) 763-2233

ENGINEERING SERVICES CO.
6717 Vernon Ave.
St. Louis, Mo. 63130
Phone: (314) 726-2233

7924-A State Line
Prairie Village, Kansas 66208
Phone: (913) 649-4000

1026 Third Ave., S.E.
Cedar Rapids, Iowa 52403
Phone: (319) 366-1591

LOUIS A. GARTEN & ASSOCIATES
375 Passaic Avenue
Fairfield, N. Jersey 07006
Phone: (201) 226-7800

947 Old York Road
Abington, Pa. 19001
Phone: (215) 927-1200

JAMES L. HIGHSMITH & CO.
P.O. Box 9367
Charlotte, N. Carolina 28205
Phone: (704) 333-7743

P.O. Box 7835
Orlando, Fla. 32804
Phone: (305) 293-5202

3322 S. Memorial Parkway
Suite 18
Huntsville, Alabama 35801
Phone: (205) 881-3294

P.O. Box 9225
Richmond, Va. 23227
Phone: (703) 266-2060

BOB HOCKER & ASSOCIATES
1400 Devereux Drive
Dayton, Ohio 45419
Phone: (531) 298-8638

26847 Grand River Ave.
Detroit, Michigan 48240
Phone: (313) 531-1403

KLM ASSOCIATES
1 Nouvelle Park
New Hartford, New York 13413
Phone: (315) 736-2450

8 Bear Hill Drive
Palmyra, New York 14522
Phone: (315) 597-9776

201 S. Main St.
N. Syracuse, New York 13212
Phone: (315) 458-6214

MEGATEK, INC.
1915 N. Harlem Ave.
Chicago, Ill. 60635
Phone: (312) 889-1277

NINE ASSOCIATES, INC.
P.O. Box 328
Annandale, Va. 22003
Phone: (703) 256-9105

HOWARD J. SCHUFT CO., INC.
815 Washington St.
Newtonville, Mass. 02160
Phone: (617) 527-5304

965 Dixwell Ave.
New Haven, Conn. 06514
Phone: (203) 865-1365

T. LOUIS SNITZER CO.
9005 Exposition Blvd.
Los Angeles, Calif. 90034
Phone: (213) 836-6170

1020 Corporation Way
Palo Alto, Calif. 94303
Phone: (415) 968-8304

1150 Camino del Mar
Del Mar, California 92014
Phone: (714) 545-2191

15 North 40th Place
Phoenix, Arizona 85034
Phone: (602) 273-1673

www.manualsplus.com
1006891